current is the rate of change of charge, the **v-i** relation can be expressed in differential or integral form.

$$i(t) = C\frac{d}{dt}v(t) \ or \ v(t) = \frac{1}{C}\int_{-\infty}^{t} i(\alpha)d\alpha$$

If the voltage across a capacitor is constant, then the current flowing into it equals zero. In this situation, the capacitor is equivalent to an open circuit. The power consumed/produced by a voltage applied to a capacitor depends on the product of the voltage and its derivative.

$$p(t) = Cv(t)\frac{d}{dt}v(t)$$

This result means that a capacitor's total energy expenditure up to time t is concisely given by

$$E(t) = \frac{1}{2}Cv^2(t)$$

This expression presumes the **fundamental assumption** of circuit theory: **all voltages and currents in any circuit were zero in the far distant past (t = −∞)**.

3.2.3 Inductor

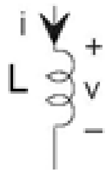

Figure 3.4 Inductor

The inductor stores magnetic flux, with larger valued inductors capable of storing more flux. Inductance has units of henries (**H**), and is named for the American physicist Joseph Henry8 . The differential and integral forms of the inductor's **v-i** relation are

$$v(t) = L\frac{d}{dt}i\left(t\right) \ or \ i(t) = \frac{1}{L}\int_{-\infty}^{t} v(\alpha)d\alpha$$

The power consumed/produced by an inductor depends on the product of the inductor current and its derivative

$$p(t) = Li(t)\frac{d}{dt}i(t)$$

and its total energy expenditure up to time t is given by

$$E(t) = \frac{1}{2}Li^2(t)$$